upper beak'' was extracted by Landauer (1941) from a Houdan cross-bred flock. Originally it produced extreme inhibition of the growth of the maxilla and of the long bones of the limbs, usually resulting in death before hatching. Continued selection resulted in a stock in which the effects of the gene are much less severe and the homozygotes are often viable.

One would have imagined that the presence of the ''short upper beak'' would always prevent hatching, but this is not so, for Hilprecht (1956) has recorded Mute Swans *Cygnus olor* Linnaeus, both on Lake Geneva and in Hamburg with this condition, so that they had to feed with their heads on one side. The Curlew is obviously a further case in point.

It is of interest that six examples of congenital bill deformities should have been found at the Wildfowl Trust in 1961, whereas none was found in 1962. One is tempted to wonder whether there is any underlying external cause at work. Waddington records that insulin injections to 5-day embryos produce ''short upper beak'' deformities. The recent discovery that an infertile egg of a Peregrine *Falco peregrinus* Linnaeus from Perthshire contained no less than four toxic agricultural sprays of the chlorinated hydrocarbon group brought this to mind. (Moore and Ratcliffe, 1962.) These must have got into the egg via the falcon, which had absorbed them from her prey, which would most likely be pigeon, which had eaten contaminated corn. Do seed dressings cause congenital deformities, as yet another harmful side-effect? Wildfowl and Curlew are corn-eaters at times and it is certainly something which should be investigated.

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Non-melanic, carotenistic and allied variant plumages in birds

by C. J. O. Harrison

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There has been some confusion in the past in the recording and description of variant plumages, especially those concerned with red and yellow pigments, and this paper represents an attempt to clarify some part of this.

Four terms are usually used in describing plumages showing variant coloration. These are:— *Melanism*, which refers to an increase in melanic pigment resulting in an abnormally dark plumage; *Albinism*, which refers

to loss of pigment producing a paler or white plumage; *Erythrism*, which refers to the replacement of black eumelanin and brown phaeomelanin by a third chestnut-red melanin, giving the plumage a reddish appearance; and *Xanthism* or *Xanthochroism*, which term must infer that there is an increase in the yellow pigment resulting in a plumage which appears yellow or yellower than the normal.

It is the latter term which has been used for the type of variant plumages which are described here. It would appear that there has been confusion between two entirely different forms of plumage variation, and that some plumages which have been described as Xanthic are the result of schizochroism, while others are true carotenistic or allied variants. In describing and discussing such plumages it has not been possible to make an exhaustive search through literature but it is considered that the variant individuals examined, or to which reference has been found, are sufficient to indicate the different types of colour change that occur. Most of the study skins examined are those in the collection of the British Museum (Natural History) and, where reference is made to these, the reference number is given.

SCHIZOCHROISM

Within many populations of birds having plumages containing melanin pigments individuals occur in which this pigment is absent. This loss can be of two types. ''Leucistic'' individuals have melanin pigment present which colours the body, giving dark eyes and colouring the soft parts, but the melanin does not enter the feather structure and the plumage is white. ''Albinistic'' individuals show an absence of melanin in the body as well as the plumage, the most obvious indication of this being the pink colour of the eyes.

If a carotene or similar pigment is present this may not be affected by the loss of melanin. The species in which this is most clearly seen, and in which it is most widely known, is the Budgerigar, *Melopsittacus undulatus*. Loss of melanin can occur together with retention of the yellow pigment present in most of the plumage, resulting in a bird which appears yellow in colour. The converse situation can occur in which the yellow pigment is lost but the melanin remains. The structural element also present in the feathers modifies the appearance of the eumelanin, and the bird appears blue in colour. This phenomenon of the separation and loss of pigments, resulting in individuals differing in colour from the normal, the colour of which was due to the combined effect of the pigments, is called schizochroism. In the case of similar pigment separation in a species such as the Canary, *Serinus canarius*, one can describe the yellow form as a non-melanic example of melano-carotenoid schizochroism, and the equivalent form which lacks the yellow pigment as a non-carotenoid form of melano-carotenoid schizochroism. Unfortunately there is no similar term available for the Psittacidae. It has been found that the red and yellow pigments of many parrots, including the Budgerigar, are not carotenes, and these have at present no name (Fox and Vevers 1960). As a result it is not possible to define the plumage variants in similar terms although the homology can be recognised. The vernacular name used for red-eyed yellow-plumaged

varieties of both parrots and finches is "Lutino". This is unsatisfactory, firstly because homologous plumages in some species are not necessarily yellow, and secondly because lutein is a particular carotene pigment which is not found in the Psittacidae and Fringillidae.

Melanic schizochroism can occur (Harrison 1963) in which the eumelanin and phaeomelanin are separated to produce either fawn or grey individuals. This is of comparatively frequent occurrence in many avian families. The non-melanic examples of melano-carotenoid schizochroism, or its equivalent form, appear in a number of species. The following list, while not exhaustive, give some idea of the range of families in which this variant can occur.

COLUMBIDAE

Many-coloured Fruit Dove, *Ptilinopus perousii*. (B. M. no. 1864. 4. 7. 3). This is one of the fruit pigeons which are normally mainly green in colour. In this specimen the plumage is yellow where it would normally be green, and white where the normal bird is grey. (See Goodwin 1959).

PSITTACIDAE

Budgerigar. *Melopsittacus undulatus*. The non-melanic form is widely bred in captivity, and is typically yellow, with white on the flight feathers and tail. The black barring on wing-coverts, mantle and head, together with the moustache streaks and spots below the bill, are replaced by unpigmented areas which appear white.

Nyasa Lovebird, *Agapornis lilianae*.
Alexandrine Parrakeet, *Psittacula eupatria*.
Plum-headed Parrakeet, *Psittacula cyanocephala*.
Ring-necked Parrakeet, *Psittacula krameri*.
Red-rumped Parrakeet, *Psephotus haematonotus*.
Blue-winged Grass Parrakeet. *Neophema chrysostomus*.

Boosey (1962) records non-melanic examples of the above species, in which those parts of the plumage which are normally green appear yellow. The absence of melanins also modifies the colour of areas of signal plumage on such individuals where the apparent colour was partly due to melanin. The red face-patch of *A. lilianae* is not affected, but the maroon wing-patches of *P. eupatria* become brick-red. The head of *P. cyanocephala* retains its rose-pink colour in the variant birds but lacks the bluish bloom of the normal individual. *P. krameri* is peculiar in that the black of the neck-ring is retained in the yellow variety. This suggests that this signal plumage is controlled by a different gene. *Psephotus haematonotus* shows sexual difference, the cock retaining some melanin and appearing pale green. The red rump is retained in the non-melanic form.

African Grey Parrot, *Psittacus erithacus*. The normal bird is grey with a scarlet tail. Non-melanic individuals are white with a scarlet tail. There is a mounted specimen of this variety in the public gallery of the British Museum (Natural History).

SYLVIINAE

Wood Warbler, *Phylloscopus sibilatrix*. Sage (1962) illustrates a non-melanic hen of this species. The bird is dark-eyed and appears to be a

leucistic form. Loss of melanin is not complete. There appears to be a faint suggestion of it on the head, and a dark feather near the carpal joint of the left wing. The bird is described as primrose-yellow on head and back, and darker yellow on the shoulders and tail-coverts, with white under parts and white outer tail feathers. It was associating with a cock which showed partial melanin loss, resulting in a yellow patch on the crown, the plumage being otherwise normal.

PARIDAE

Blue Tit, *Parus caeruleus*. Rollins (1962) has described a non-melanic individual. This was white on the head, wings, and tail, with yellow on back, rump, scapulars, and under parts.

FRINGILLIDAE

Canary, *Serinus canarius*. The yellow form of the canary originated as a non-melanic form, but the distribution of yellow in many individuals suggests that mutations have arisen since in which here has been an increase in the distribution of carotene pigments over the plumage.

Siskin, *Carduelis spinus*. The non-melanic form has been bred in captivity. In an article in "Cage Birds" of 4th February 1960, R. Jefferson described and illustrated an example of this. He had bred two such birds, both cocks, which were described as yellow in colour, with faint traces of the normal melanin pattern appearing on feathers acquired at the first moult.

Greenfinch, *Carduelis chloris*. This again has been bred in captivity. Non-melanic hens are mainly white with yellow on belly, wing-flashes, and outer tail feathers. The cocks are yellow over much of the body, having a more extensive distribution of carotene pigment than the hens.

Goldfinch, *Carduelis carduelis*. Stresemann (1924) described a Goldfinch lacking melanin pigment. This bird was white with a red face-patch and the normal yellow bars on the wings.

PLOCEIDAE

Black-headed or Golden-backed Weaver, *Ploceus jacksoni*. A wild-caught specimen from Uganda (B. M. no. 1929. 1. 7. 43) is almost entirely yellow, this being deepest on the head, wings, and tail. The normal adult cock has a black head, chestnut mantle, and the feathers of wings and tail mainly black and greenish.

ESTRILDIDAE

Common or St. Helena Waxbill, *Estrilda astrild*. A specimen taken in the Sudan (B. M. no. 1887. 9. 28. 126) is white instead of the normal brown, but retains the scarlet streak through the eye, and a pink patch on the belly.

It can be seen from descriptions given here that the loss of melanin does not cause an alteration in the distribution of the other pigments present. The carotenes and other pigments appear in those parts of the plumage where they are apparent in the normal bird. It would however appear, as is the case of the weaver, that heavy melanisation of plumage may mask the carotenoid pigment also present in the feathers. Both types of non-melanic variants may retain non-melanic pigments, and the non-melanic

individuals described might be either leucistic or melanistic. Both types of yellow individual have been bred in the Budgerigar. In such plumages as have been described here there is no evidence of feathers becoming yellow or yellower, but merely of melanin loss revealing pigments already present. The term "xanthic" or "xanthochroic" would appear inapplicable to such variant plumages.

CAROTENISTIC AND ALLIED VARIANTS

It has been possible to find only four examples of apparent mutations modifying the visual appearance of red or yellow pigments. Three of these are concerned with carotenes and could be called examples of carotenism, one of these being of a type which might qualify as xanthism in the strict sense of the term. The fourth example is concerned with pigment in a species of parrot. The latter example was also described by Rensch (1925) who used the term "lipochroismus" when describing it.

These examples appear to show four different types of variation, involving:—

a. Change in distribution of pigment.
b. Increase in the amount of pigment.
c. Change in colour of pigment.
d. Replacement of melanin by a non-melanic pigment.

Change in the distribution of the pigment, which in this case is carotene, was shown by a Goldfinch, *Carduelis carduelis*, bred in captivity by S. Evans, and described by him in "Cage and Aviary Birds" 13th September 1962, p. 256. According to this description the red colour, usually confined to the anterior part of the head, extends back to the black band at the back of the head, and the usual narrow grey band on the nape is replaced by red and bronze. The breast is orange, and this extends right to the under tail-coverts. The normally light brown contour feathers are a rich reddish-brown. In addition to the yellow on the flight feathers, the rump and markings on the tail, normally white, are yellow in this bird. The red and yellow carotenes, normally present in part of the plumage appear to have spread to both the unpigmented and melanised feathers.

Increase in the amount of pigment present was shown by a specimen of the Blue-headed Wagtail, *Motacilla flava flava*, collected in Africa by Dr. W. Serle, described by him (1959) and now in the collection of Dr. J. M. Harrison. Serle described the bird as orange in colour, but in a more recent examination of the specimen it was found that the colour difference was less marked than this. The normal bright lemon-yellow of the under side of the species was, in this specimen, a very deep yellow with a slight orange tint, similar to the Deep Chrome of Ridgway's colour standards. The olive-green of mantle, back and rump, was modified to a bright golden green rather similar to that found on the mantles of some tropical woodpecker species, while most of the rest of the plumage, apart from the head, was suffused with this deep yellow tint. The head was the normal pale blue and white of the adult male, but Milne (1959) has pointed out that in this species head coloration appears to be controlled by genes different from those responsible for the colour of the rest of the plumage, and varies independently.

The difference in colour between this individual and the normal members of the species is very similar to that shown by "colour-fed" canaries compared with the usual non-melanic yellow forms. In colour-feeding the individual is fed during the period of moult with food rich in red carotenes. Although the canary is unable fully to utilise red carotene or convert yellow carotene to red pigment in the way that the goldfinch is said to do, a certain amount of the red carotene is taken up and the plumage, instead of appearing pale yellow, became deep yellow or almost orange. This is purely temporary and depends on the food taken during or before the moult. One may speculate on the possibility that the abnormal colour shown by the wagtail might have been a temporary change due to nutrition rather than a permanent mutation.

To some extent the latter specimen shows evidence of the third type of variation; namely change in the colour of the non-melanic pigment. A more marked example of this was a Green Woodpecker, *Picus viridis*, recorded by Col. R. Meinertzhagen, who possesses a painting of the bird together with a tuft of feathers from it (Meinertzhagen 1963). In this species the normal green colour of most of the plumage is produced by melanin combined with a yellow pigment. In the individual concerned this yellow was mostly replaced or masked by a red pigment, so that the bird has a striking orange-red coloration. This effect can again be reproduced artificially. During a study of the loss of red colour in the plumage of captive birds of various species Rhodoxanthine, an extract of the red pigment found in Yew (*Taxus baccatus*) berries, was given to various species during the moult (Völker 1958). When this was fed to Goldfinches (*Carduelis carduelis*) it was found that the normally yellow wing bar became red. This again was a temporary effect, and one may speculate as to whether the abnormal colour shown by the woodpecker had a genetic or nutritional origin.

The last type of variation appears to be peculiar to the Psittacidae. Rensch (1925) described an example of the African Grey Parrot, *Psittacus erithacus*, in which odd grey feathers were replaced by red feathers at successive moults. The normal plumage of this species is grey, with a scarlet tail, and these new feathers resembled the tail in colour. There is a specimen of this species in the British Museum (B.M. No. 1887, 9, 28, 291) taken in Africa, in which the greater part of the plumage shows this red colour. The breast, belly and under tail-coverts are pinkish red with a few grey feathers, the upper breast and throat are grey with scattered pink feathers. The flanks, rump, upper tail-coverts, back, and tertials are a deeper red, more like that of the tail, with one or two grey feathers. The lesser wing-coverts are mainly red, and the mantle, greater coverts, and flight feathers are grey with a few red feathers irregularly distributed. Only the ear-coverts, crown, and nape, are pure grey. Some of the grey feathers of the body are tinted with red, or show an irregular distribution of grey and red pigment replacing each other on the feather. Yealland (1960) also mentions the tendency shown by this species to show red feathers in the plumage.

Boosey (1962) writing of the non-melanic variety of the Red-rumped Parrakeet, *Psephotus haematonotus*, records the following—". . . one of

our yellow hens, which was for two years a normal Yellow except for a few red feathers on the rump, moulted out during 1951 with all her plumage spotted with red feathers, particularly on the wings.'' The red on the rump is normally present only in the male of this species.

GENERAL COMMENTS

Of the variant plumages described here, those in the first group cannot be regarded either as xanthic plumages or as carotenoid variants, but are simply non-melanic examples of schizochroism. This was recognised by Van Tyne and Berger (1960) who described xanthism as a form of schizochroism, giving the non-melanic form of the Budgerigar as an example.

The remaining four examples all represent variants in which the yellow or red pigments present differ from the normal in quantity, distribution, or appearance. The first three might be described as examples of ''carotenism'' if this term is used in the rather vague and loose sense in which the terms albinism and melanism are usually applied; but it is probably true to say that these are not covered by current terminology.

The schizochroic variants described could potentially occur in any species having both melanic and non-melanic pigments. The carotenistic variants are either accidents of nutrition, or else they represent new mutations within the species concerned.

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The differences between *Pitta guajana guajana* and *P.g.affinis*

by A. HOOGERWERF

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On an earlier occasion I published a paper[1] on this subject. After studying some more material I add a few notes.

Voous[2] identified a bird of this species from Mt. Slamet (western part of Central Java) as West Java's *affinis*. The sex of this bird is not mentioned but on account of the wide breast band (6 mm.) I am inclined to consider it a male. It is classified as *affinis* because of the narrow breast band and the yellowish-buff under parts.